

WHAT IS CLAIMED IS:

1. A transmission span for a telecommunications link, comprising:
 - a first segment comprising a first optical fiber having a first fiber length and a first physical property;
 - a second segment comprising a second optical fiber having a second fiber length and a second physical property;
 - a third segment comprising a third optical fiber having a third fiber length and a third physical property, the first and third segments optically coupled to opposing ends of the second segment, and wherein at least one of the first and third physical properties is different from the second physical property, wherein the first segment provides low nonlinearity, the third segment provides distributed gain, and the second segment compensates for the dispersion of the first and third segments; and
 - a fourth optical fiber doped with a non-zero concentration of Er^{3+} , wherein the fourth optical fiber is disposed at a location in the span for remote pumping, the location selected from the group consisting of within the first segment, within the second segment, within the third segment, at an interface between the first and second segments, and at an interface between the second and the third segments, wherein the fourth optical fiber provides discrete amplification of the optical signal.
2. The transmission span according to claim 1, wherein the first optical fiber is a fiber selected from the group consisting of SMF type fibers, SCF type fibers, and NDSF type fibers, having an effective mode field area of from about $70 \mu\text{m}^2$ to about $120 \mu\text{m}^2$, the second optical fiber is an inverse dispersion fiber having an effective mode field area of about $15 \mu\text{m}^2$ to about $40 \mu\text{m}^2$, and the third optical fiber is a non-zero dispersion shifted fiber having an effective mode field area of from about $45 \mu\text{m}^2$ to about $70 \mu\text{m}^2$.

3. The transmission span according to claim 1, wherein the Er^{3+} dopant concentration is from about 100 parts per million (ppm) by weight to about 1000 ppm by weight and wherein a length of the fourth optical fiber is from about 10 m to about 100 m.

4. The transmission span according to claim 3, wherein the Er^{3+} dopant concentration is from about 200 parts per million (ppm) by weight to about 500 ppm by weight.

5. The transmission span according to claim 1, wherein the fourth optical fiber is disposed at the interface between the second and the third segments.

6. The transmission span according to claim 1, wherein the fourth optical fiber is disposed at the interface between the first and second segments.

7. The transmission span according to claim 1, wherein the fourth optical fiber is disposed within the first segment.

8. The transmission span according to claim 1, wherein the fourth optical fiber is disposed within the second segment.

9. The transmission span according to claim 1, wherein the fourth optical fiber is disposed within the third segment.

10. The transmission span according to claim 1, wherein the fourth optical fiber is disposed at a location in the span that reduces a signal to noise degradation.

11. The transmission span according to claim 1, wherein the length of the third fiber segment is shorter than the length of the second fiber segment and is shorter than the length of the first fiber segment.

12. A method of providing a transmission span that compensates for signal attenuation, dispersion, and nonlinearity of an optical signal communicated between two line units and provides distributed amplification, comprising:

dividing the transmission span into a plurality of fiber segments;

selecting a different fiber for each of the segments so that a first segment provides low nonlinearity, a third segment provides distributed gain, and a second segment compensates for the dispersion of the first and third segments, the dispersion being based on a dispersion condition and a dispersion slope condition for the span; and

inserting an Er^{3+} doped optical fiber into the transmission span at a location selected from the group consisting of within the first segment, within the second segment, within the third segment, at an interface between the first and second segments, and at an interface between the second and the third segments, wherein the Er^{3+} doped optical fiber provides discrete amplification of the optical signal.

13. The method according to claim 12, wherein the Er^{3+} doped optical fiber is inserted at a location at least 2 kilometers in distance from both of the line units.

14. A telecommunications system for communicating an optical signal, comprising:

a first transmission span; wherein the first transmission span includes

a first segment comprising a first optical fiber having a first fiber length and a first physical property,

a second segment comprising a second optical fiber having a second fiber length and a second physical property,

a third segment comprising a third optical fiber having a third fiber length and a third physical property, the first and third segments optically coupled to opposing ends of the second segment, and wherein at least one of the second and third physical properties is different from the first physical property, wherein the first segment provides low nonlinearity, the third segment provides primary distributed gain, and the second segment compensates for the dispersion of the first and second segments, and

a fourth optical fiber doped with a non-zero concentration of Er^{3+} , wherein the fourth optical fiber is disposed at a location in the span for remote pumping, the location selected from the group consisting of within the first segment, within the second segment, within the third segment, at an interface between the first and second segments, and at an interface between the second and the third segments, wherein the fourth optical fiber provides discrete amplification of the optical signal;

a first line unit disposed at a first end of the first transmission span; and

a second line unit disposed at a second end of the first transmission span, wherein the optical signal propagates from the first line unit to the second line unit along the first span in a first direction, and wherein the second line unit provides a plurality of pump beams into the first span in a second direction opposite to the first direction to provide remote pumping for discrete Erbium amplification and distributed Raman amplification of the optical signal.

15. The telecommunications system of claim 14, wherein the pump beams generated by the second line unit include a first set of pump beams and a second set of pump beams, and wherein the first set of pump beams have a shorter wavelength and a lower intensity than the second set of pump beams.

16. The telecommunications system of claim 14, wherein the first optical fiber is a fiber selected from the group consisting of SMF type fibers, SCF type fibers, and NDSF type fibers, having an effective mode field area of from about $70\text{ }\mu\text{m}^2$ to about $120\text{ }\mu\text{m}^2$, the second optical fiber is an inverse dispersion fiber having an effective mode field area of about $15\text{ }\mu\text{m}^2$ to about $40\text{ }\mu\text{m}^2$, and the third optical fiber is a non-zero dispersion shifted fiber having an effective mode field area of from about $45\text{ }\mu\text{m}^2$ to about $70\text{ }\mu\text{m}^2$, and wherein the fourth optical fiber is doped with an Er^{3+} dopant concentration from about 100 parts per million (ppm) by weight to about 1000 ppm by weight.

17. The telecommunications system of claim 16, wherein a length of the fourth optical fiber is from about 10 m to about 100 m.

18. The telecommunications system of claim 14, wherein the location of the fourth optical fiber is at least 2 kilometers in distance from the line units.

19. The telecommunications system of claim 14, wherein the location is selected to provide remote pre-amplification of the optical signal.

20. The telecommunications system of claim 14, wherein the location is selected to provide remote post-amplification of the optical signal.

21. A transmission span for a telecommunications link, comprising:
a first segment comprising a first optical fiber having a first fiber length and a first physical property;

a second segment comprising a second optical fiber having a second fiber length and a second physical property different from the first physical property, the first segment optically coupled to the second segment, wherein the first optical fiber mitigates nonlinearity and the second optical fiber provides dispersion compensation

for the first fiber and a distributed gain medium, wherein the first optical fiber is selected from the group consisting of SMF type fibers, SCF type fibers, and NDSF type fibers having an effective mode field area of from about $70\ \mu\text{m}^2$ to about $120\ \mu\text{m}^2$ and the second optical fiber is an inverse dispersion type fiber having an effective mode field area of about $15\ \mu\text{m}^2$ to about $40\ \mu\text{m}^2$; and

a third optical fiber doped with a non-zero concentration of Er^{3+} , wherein the third optical fiber is disposed at a location in the span for remote pumping, the location selected from the group consisting of within the first segment, within the second segment, and at an interface between the first and second segments, wherein the third optical fiber provides discrete amplification of the optical signal.

22. The transmission span according to claim 21, wherein the Er^{3+} dopant concentration is from about 100 parts per million (ppm) by weight to about 1000 ppm by weight and wherein a length of the fourth optical fiber is from about 10 m to about 100 m.

23. The transmission span according to claim 21, wherein the length of the second fiber segment is shorter than the length of the first fiber segment.